

Scaphometacarpal Space and Postoperative Outcomes: A Systematic Review

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Abstract

Background A common notion is that more complex techniques for treating trapeziometacarpal arthritis such as ligament reconstruction and tendon interposition (LRTI) better preserve the scaphometacarpal (SMC) space compared to a simple trapeziectomy and that this leads to superior functional outcomes.

Purpose The purpose of this systematic review is to evaluate the relationship between scaphometacarpal space and objective outcomes such as grip and pinch strength as well as subjective patient-reported outcomes.

Methods A systematic review of the literature was conducted according to PRISMA guidelines. Inclusion criteria were studies reporting SMC space and outcomes after surgery for carpometacarpal arthritis. The primary outcomes of these studies included any measure of postoperative scaphometacarpal space (trapezium height/trapezium index) as well as key pinch strength, grip strength, or lateral pinch strength. Studies that did not assess for association between SMC space and outcomes were excluded.

Results Fourteen studies were included in this systematic review. Three (21.4%) studies found a statistically significant correlation between postoperative SMC space and postoperative pinch or grip strength. The correlation was weakly positive in one study (key pinch vs. scaphometacarpal space, $r = 0.13$), positive but unlisted in another (lateral pinch vs. trapezium ratio), and negative in the third study (key pinch vs. trapezium space ratio, $r = -0.47$).

Conclusion Preservation of the SMC space postoperatively is not associated with postoperative outcomes. Further research is necessary to better characterize the importance of maintaining the SMC space in patients undergoing LRTI in order to substantiate claims by proponents of the procedure.

Keywords

- ▶ scaphometacarpal space
- ▶ trapeziectomy
- ▶ CMC arthritis
- ▶ LRTI

A major breakthrough in the surgical treatment of carpometacarpal (CMC) osteoarthritis (OA) was made when Gervis published his results with trapeziectomy in 1949, a procedure in which the arthritic trapezium is removed.¹ Symptomatic relief was experienced by patients, but complaints of weakness and instability prompted others to propose a series of modifications to the original procedure.² This weakness

after trapeziectomy has been attributed in part to collapse of the scaphometacarpal (SMC) space, the void left between the scaphoid and metacarpal after the trapezium is removed.³ Many subsequent variations of trapeziectomy have attempted to confront the preservation of the SMC space.

One of these novel methods of treating CMC OA, trapeziectomy with ligament reconstruction and tendon interposition

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(LRTI), was proposed by Pellegrini and Burton in 1986.⁴ Over the subsequent decades, this procedure has trumped simple trapeziectomy as the most commonly performed surgical treatment for thumb CMC OA.⁵ Despite its fervent adoption by hand surgeons in the clinical setting, many studies have failed to show any benefit of trapeziectomy with LRTI over other forms of trapeziectomy in improving postoperative pinch or grip strength.^{6,7} A recent Cochrane Review supported these findings.⁸

Central to hand surgeons' adoption of LRTI is the notion that the procedure better preserves the SMC space than alternative forms of trapeziectomy, and in doing so, produces superior functional outcomes.^{9–13} Both of these assumptions remain controversial in the literature.^{6,14} The purpose of this systematic review is to evaluate the relationship between scaphometacarpal space and objective outcomes such as grip and pinch strength as well as subjective patient-reported outcomes. This review considered all possible variations of trapeziectomy but focuses upon LRTI because of its prevalence as a therapy for thumb CMC OA and its use of tendon interposition. In doing so, we aim to reconcile the disparity between clinical practice and evidence-based study on the utility of the SMC space.

Methods

A systematic review was conducted using Pubmed, Embase, Ovid, and Web of Science. Initial title and abstract screening and secondary full text screening was conducted by two blinded reviewers. All disagreements were resolved through discussion.

Eligibility criteria for inclusion were peer-reviewed publications that reported any measure of scaphometacarpal space (trapezium height and/or trapezium index) and postoperative outcomes including at least key pinch strength, grip strength, and/or lateral pinch strength. Subjective outcomes such as Disabilities of the Arm, Shoulder, and Hand (DASH) scores and pain visual analog scale (VAS) for pain were also assessed from included studies. Studies that did not conduct analysis on the association between SMC space and postoperative outcomes were excluded. No limitations were placed upon year of publication for inclusion into this systematic review. English and non-English language articles were considered. Articles on trapeziectomy (T), partial trapeziectomy (PT), trapeziectomy with ligament reconstruction (LR), trapeziectomy with hematoma distraction arthroplasty (HDA), trapeziectomy with interposition arthroplasty (IA), trapeziectomy with ligament reconstruction and tendon interposition (LRTI), and trapeziectomy with suture button suspensionplasty (SBS) were included. Publications reporting outcomes related to prosthetic arthroplasty were excluded.

A combination of the following terms were searched: "scaphometacarpal space," "metacarpal subsidence," "metacarpal settling," "trapezium height," "trapezium space ratio," "trapezium ratio," "trapezium index," and "trapezium space." Both absolute and normalized measures of scaphometacarpal space were acceptable for the purposes of this analysis.

Because absolute SMC space (distance from the scaphoid to the first metacarpal) and trapezium space ratio (SMC space normalized by length of the first metacarpal) represent measures of SMC space, we will refer to both as SMC space in this systematic review.

Results

There were 601 results obtained from our search. Removal of duplicates resulted in 420 studies remaining. After title and abstract screening, there were 163 full-length publications reviewed by two independent reviewers. These two reviewers agreed upon the inclusion of 14 studies that analyzed the correlation between the scaphometacarpal space and postoperative strength outcomes.^{15–29} A summary of our systematic review process can be found in ►Fig. 1.

There were nine retrospective studies and five prospective studies included in this analysis. Eight of the studies calculated scaphometacarpal space, five calculated trapezium ratio alone, and one study calculated both.

Of these 14 studies, 3 (21.4%) found a statistically significant correlation between postoperative SMC space and postoperative pinch or grip strength. The correlation was weakly positive in one study (key pinch force vs. scaphometacarpal space, $r = 0.13$),²⁵ positive but unlisted in another (lateral pinch vs. trapezium ratio),²² and negative in the third study (key pinch vs. trapezium space ratio, $r = -0.47$).²⁰ All other studies included in this systematic review found no statically significant correlation between SMC space and

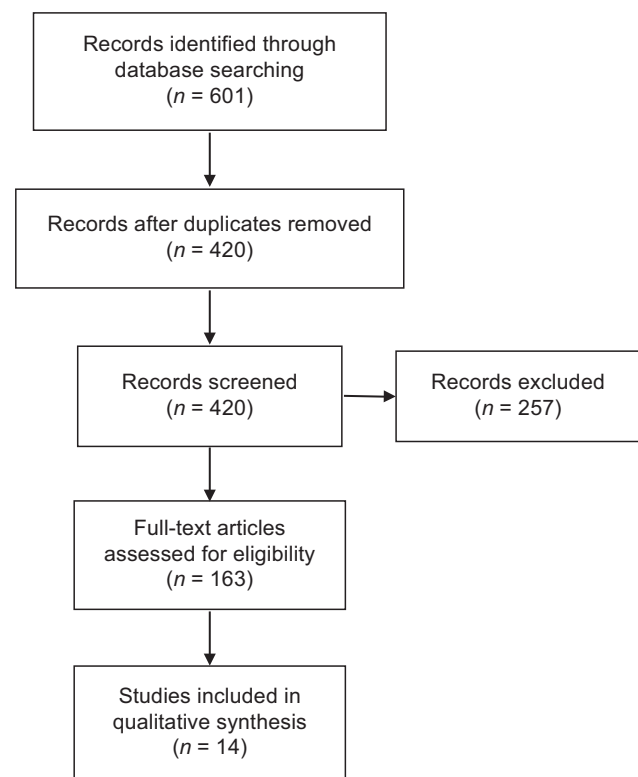


Fig. 1 PRISMA Flow Diagram of literature search, duplicate removal, title and abstract screening, full-text screening, and final studies included in systematic review.

postoperative pinch or grip strength. These results can be found in ►Table 1.

Ten of the 14 studies analyzed the correlation between SMC space and subjective outcomes. Subjective outcomes included pain and function VAS as well as DASH scores. All 10 studies found no correlation between the SMC space and patient-reported measures. These results can be found in ►Table 2.

Discussion

When part or all of the trapezium is removed, surgeons have a choice regarding the remaining SMC space: fill it with interposition arthroplasty (IA, LRTI) or allow it to be filled by the body's natural response to injury (T, HDA, LR, and SBS). The evidence on how well each of these approaches maintains the SMC space is unclear, but importantly, more invasive interventions appear to yield no additional returns in objective measures of postoperative strength.⁸ Despite the lack of evidence supporting LRTI, the preference of surgeons in the United States is very clear, with the procedure being completed 93% of the time in a recent study analyzing a national Medicare database.⁵ The high utilization of LRTI may be related to the misconception that increased SMC space is a predictor of superior functional outcomes.^{9–13}

The authors of this article endorse that maintenance of the SMC space is important to prevent abutment between the first metacarpal base and scaphoid, a dreaded postoperative com-

plication.²⁰ However, the literature confirms the degree to which the space is maintained after surgery does not directly translate into any return in objective and subjective functional outcomes.^{15–19,21,23,24,26–29} Additionally, with most treatments for CMC OA being deadlocked in producing clinical outcomes, LRTI appears to be longer, costlier, and riskier for patients undergoing surgery with no apparent benefit.^{5,8} Thus, we echo the sentiments of Yuan et al that less invasive and more cost-effective forms of trapeziectomy such as simple trapeziectomy deserve greater utilization.⁵

The authors of this systematic review did not conduct a meta-analysis because of the limited reported data existent in the literature. Studies that found no significant association between postoperative scaphometacarpal space and height did not report the results of their statistical analysis. These studies formed the majority of our systematic review. Of the few studies that did report statistically significant correlations, two of the three found a positive association between SMC space and outcomes. Conducting a meta-analysis with these data would not be representative of the literature as a whole. Another limitation of this systematic review was that most studies that analyzed the association between SMC space and outcomes were retrospective in nature and may have also been statistically underpowered to detect any meaningful relationship between the two parameters. Although there was no additional analysis conducted on the studies included, our study represents an exhaustive exploration and consolidation of existing knowledge on the

Table 1 A summary of sources included in this systematic review

Author	Year	Study Design	SMC	Procedure	Thumbs	Follow-up	Correlation
Dell	1987	Retrospective	Space	IA	28	2.5	No
Lins	1996	Retrospective	Ratio	LRTI	30	113	No
Atroshi	1997	Prospective	Space	IA	17	39	No
Yang	1998	Retrospective	Ratio	LRTI	15	32	No
Belcher	2000	Prospective	Space	T/LRTI	43	14	No
Downing ^a	2001	Prospective	Space + ratio	T/IA/LRTI	26/23/24	12	$r = -0.47^b$
Mureau	2001	Retrospective	Ratio	IA	24	72	No
Budoff ^a	2002	Retrospective	Space	LR	29	61	Unlisted ^c
Nusem	2003	Retrospective	Ratio	IA	35	60	No
Kuhns	2003	Prospective	Space	HDA	26	24	No
De Smet ^a	2004	Prospective	Space	T/LRTI	22/34	34/26	$r = 0.13^d$
Mo	2004	Retrospective	Ratio	T/LRTI	14	20	No
Demir	2005	Retrospective	Space	LR	79	35	No
Sandvall	2010	Retrospective	Space	LRTI/HDA	11/9	29/22	No

Abbreviations: HDA, hematoma distraction arthroplasty; IA, interposition arthroplasty; LR, ligament repair; LRTI, ligament repair tendon interposition; PT, partial trapeziectomy; SMC, scaphometacarpal; T, trapeziectomy.

Note: First author, year of publication, study design (retrospective or prospective), methodology of reporting height of scaphometacarpal (SMC) space (SMC space, trapezial ratio, or both), study design (retrospective or prospective), procedure type (studies analyzing multiple procedures have data specific to each procedure separated by a slash), number of thumbs, follow-up (months), and correlation between strength and space with statistically significant correlations listed.

^aStatically significant correlation between strength and space determined.

^bKey pinch vs. trapezial space ratio.

^cTip pinch vs. scaphometacarpal space in LR group.

^dKey pinch vs. Scaphometacarpal space.

Table 2 This table explores the reported correlation between SMC space and subjective outcomes (patient-reported pain, hand functionality)

Author	Patients	Subjective outcome	Correlation: outcome vs. SMC space
Dell PC	26	Pain Relief	No
Lins	27	Patient satisfaction, symptom survey	No
Atroshi I	17	Pain VAS	No
Yang SS	13	Patient satisfaction	No
Belcher	36	ADL score, function VAS, pain VAS	No
Downing	67		–
Mureau	26	Pain VAS, weakness VAS	No
Budoff	26	Functional performance, pain survey	No
Nusem	30		–
Kuhns	26	AIMS2 Health Status Questionnaire	No
De Smet	56		–
Mo	14	DASH score	No
Demir	49	Patient satisfaction, DASH score	No
Sandvall	20	QuickDASH, pain VAS	No

Abbreviation: SMC, scaphometacarpal.

Note: Subjective outcome measures included visual analog scales (VAS) for pain and function; Arthritis Impact Measurement Scales (AIMS); 2 Health Status Questionnaire, and Disabilities of the Arm, Shoulder, and Hand (DASH) score. “No” means there was no statistically significant correlation found, while a dashed line means the study did not complete analysis to assess the correlation of SMC space and subjective outcomes.

relationship between the SMC space and postoperative strength.

This systematic review suggests that greater maintenance of SMC space may not be associated with superior postoperative outcomes. We conclude that attempts to preserve the SMC space in the surgical management of CMC OA deserve further scrutiny.

Note

This study does not contain any studies with human participants performed by any of the authors.

Conflict of Interest

None declared.

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